

DESCRIPTION

OF THE

# Memphis Sewer System

1879 TO 1890,

INCLUSIVE,

COMPILED AND PREPARED UNDER THE SUPERVISION OF

NILES MERIWETHER,

CITY ENGINEER.

By JAMES H. ELLIOTT,

ASSISTANT ENGINEER.

MEMPHIS, TENN.

PRESS OF S. C. TOOF & COMPANY,

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## OFFICERS OF THE ENGINEER DEPARTMENT

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NILES MERIWETHER, *Taxing District Engineer.*

JAMES H. ELLIOTT, *Assistant Engineer.*

A. T. BELL, *Assistant Engineer.*

R. P. GRANT, *Superintendent Sewer Department.*

J. T. FERGUSON, *Superintendent Construction.*

WM. LUNN, *Inspector Plumbing.*



## DESCRIPTION OF MEMPHIS SEWER SYSTEM.

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So many inquiries are made concerning the sewer system of the City of Memphis, that it is deemed advisable to print in pamphlet form the sewer reports for 1889 and 1890, also to give a full account and description of the sewer system up to the present date.

During the yellow fever epidemic of 1878 and 1879 the question of sewers was agitated, resulting in the adoption of the separate system as recommended by Col. Geo. E. Waring, jr., of Newport, R. I.

From March, 1879, for about two years, Col. Geo. E. Waring, jr., was in charge as Designing and Consulting Engineer. Afterward Maj. J. H. Humphrey of Memphis was Engineer in charge of the work. During 1883 the work was turned over to the city and placed in charge of the City Engineer, Maj. Niles Meriwether. In the year 1880  $24\frac{2}{10}$  miles of sewers were built and about 6 miles during 1881, making a total of about 30 miles laid, when the city assumed charge. The following is a description of the system as furnished by Col. Geo. E. Waring, jr.:

“The unit of the system is a sewer of vitrified pipe six inches in diameter with tight joints, laid in the street (or in the alley between two streets where said alley exists), having at its upper end a ‘Rogers Field Flush Tank,’ with a discharging capacity of 112 gallons. All the houses on both sides of the sewer are connected with it by four-inch pipes of the same material. The house connection drains enter the sewer at an acute angle and by a funnel-shaped branch piece, which delivers the house waste at the bottom of the sewer and which ventilates it to its top. The house connection drain has no top, and it is continued by an untrapped soil pipe, four

inches in diameter, which continues above the roof of the house. Therefore every house connection furnishes free ventilation to the sewer. The water closets, sinks and other vessels in the house are separated from the soil pipe and drain, each by its own trap. The flush tank is fed by a constant small stream from the water works, only sufficient to fill it about once in twenty-four hours. When full, the continuance of the same small stream causes its automatic siphon to come into action, and the entire contents of the tank are discharged directly into the head of the sewer in from 36 to 40 seconds. This rapid discharge of such a volume flushes the sewer completely. At the lower end of the sewer, near its junction with the river, there is a fresh air inlet to supply the upward draft through the soil pipes of the houses.

“The six-inch sewer, after receiving not to exceed 300 house drains, discharges into a main or sub-main sewer of eight inches diameter or more, and the sub-main discharges into the larger mains. The sizes of the sub-mains and mains are of 8-inch, 10-inch, 12-inch, 15 inch and 20-inch diameters. The greatest flow of the 20-inch main sewer, about 3000 houses being connected, is about nine inches deep. Porous subsoil tile drains are laid in the same trench with the sewer, to under-drain the ground, and these discharge directly into Bayou Gayoso.”

Referring to the first report made by the City Engineer in 1882, we find the following :

“The obstructions thus far for the two years have been altogether in the 4-inch and 6-inch laterals, a total of 75. The entire cost of removing these obstructions for the two years was \$1012.55, cost per stoppage \$13.50, cleaning the mains \$285.40.

“The system in the main has so far worked admirably and has given entire satisfaction. It has, however, grown so rapidly



and now covers so much territory on the east and west sides of Bayou Gayoso that the main lines are at times taxed quite to their full capacity, showing that they will in time have to be enlarged at certain points."

In the Biennial Report made in 1884, we find for the two years 164 obstructions in the sewers, costing for removal \$1982.15, cost per stoppage \$12.10, cost of cleaning main sewers \$738.60.

The Biennial Report for 1886 shows the cost of the Monroe street intercepting sewer, which was constructed "in consequence of the excessive tax put upon the east and west mains of the original system, which had become so overcharged as to make it necessary to tap it at several points north of Monroe street with discharge pipes into the bayou." The number of obstructions for the two years were 391, costing for removal \$4215.15, cost per stoppage \$10.75, cost of cleaning main sewer \$1819.75.

The Biennial Report for 1888 shows as follows: 229 obstructions removed at a cost of \$2510.61, cost per stoppage \$10.96—with two exceptions all the stoppages occurred in 6-inch laterals—cost of cleaning main sewer \$1611.70.

## SUMMARY OF THE ABOVE.

REPORTS	No. of Obstructions	Cost of Removal	Average Cost	Cost of Cleaning Main Sewer	No. of Man- holes Built	Total Number of Manholes
1880 to 1882.....	75	\$1012.55	\$13.50	\$ 285.40	.....	36
1882 to 1884.....	164	1982.15	12.10	738.60	12	48
1884 to 1886.....	391	4215.15	10.75	1819.75	19	67
1886 to 1888.....	229	2510.61	10.96	1611.70	19	86
1888 to 1890.....	269	1286 64½	4.78	703.89½	155	241

In the years 1889 and 1890 the building of manholes was pushed forward, 155 manholes being built, the effect of which is very plain in the cost of removing stoppages and the cleaning of main sewer, besides the great saving in time and labor. During 1889 a force of nine men have attended to the removal of stoppages, cleaning of mains, putting in house connections and building manholes, etc.

A careful examination of the above figures show—

First—That the unit, or 6-inch pipe, is too small, as nearly all of the stoppages occur in them; very few in larger pipes where properly laid.

Second—That for the economical working of a system of sewers manholes are a necessity, and in this connection it is well to state that all changes of grade or direction in lines should be made in manholes, as these are the points where stoppages most occur. It is well also, in planning a system of sewers, to be careful to lay the mains deep enough and make them large enough to allow of extensions when needed.

Referring back to the extracts from the different reports, it will be noticed that as early as 1882 the main sewers were at times taxed to their full capacity. In 1885-86 the main sewers had become so overcharged as to make it necessary to tap them at several points north of Monroe street, with discharge pipes into the bayou, and to build the Monroe street intercepting 24-inch sewer a distance of 3243 feet direct to the river, at a cost of \$18,738 $\frac{91}{100}$ . Referring to the report for 1890, it will be seen that the necessity for another intercepting sewer still further south is forced upon the city.

Chelsea is the northern portion of Memphis, consisting of the Ninth Ward. It is separated from the balance of the city by Bayou Gayoso, and was not included in the Waring system.



In April, 1888, by an order of the Council, a survey was made by Mr. R. F. Hartford of Chattanooga, Tenn., and a plan submitted. In August work was started. The following description of the system is taken from Mr. Hartford's report to the Council for the years 1887 and 1888 :

“The minimum size of pipe used in lateral lines will be 8 inches. No curves will be admitted into the system, excepting in manholes, where all changes in alignment, both vertical and horizontal, will be made. A manhole will be built at every intersection, which will place them about 380 feet apart. Channels of the proper size and form, straight and curved, will be molded in the cement floors of the manholes, care being taken that sufficient fall is secured on curves to overcome all frictional resistance to flow.

“At the upper end of all lateral lines, an automatic flush tank of suitable capacity will be placed to discharge directly into the sewers.

“House connection branches will be extended to the sides of the street or alley in which the sewer may lie. They will be of 6-inch clay pipe cement jointed, and have at their upper ends an ‘increaser’ from 4 to 6 inches, to receive the house drain, which will be 4 inches in diameter. This feature will enable us to get a better fall to the house drain, and it is believed we will be relieved from the now common annoyance of opening pavements to remove obstructions in house connection branches. This district is very favorably located for the construction of a model system of sewerage, being so laid out that every portion may be served by sewers placed only in alleys, leaving the surfaces of all streets free from any future disturbance for connections, repairs, or the removal of obstructions. It is believed, however, that all danger from obstruc-

tions is removed by providing pipes of ample size and gradients, the introduction of manholes, placed within easy distances of each other, and the avoidance of all curves between."

The expenses, etc., of maintenance of this system will be kept separate and distinct from that of the Waring system, so that an intelligent comparison can in the future be made of the relative value and efficiency of the two systems.

## OPERATIONS OF SEWER DEPARTMENT IN 1880

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In the past year there have been issued vouchers and pay-rolls from this department to the amount of eighteen thousand, two hundred and eighty-four dollars and eighty cents (\$18,284.80), of which amount two hundred and two dollars and one cent (\$202.01) should be charged to the repairs of culverts, etc., (street department) and thirty-nine dollars and eighty-seven cents (\$39.87) to repairs of fire cisterns (Fire Department), thus showing eighteen thousand, no hundred and forty-two dollars and ninety-two cents (\$18,042.92) to sewers proper. Of that amount eleven thousand, four hundred and eighty-seven dollars and eleven cents (\$11,487.11) was for the construction of new lines, and four thousand, seven hundred and twenty-two dollars and forty-four cents (\$4,722.44) for maintenance of the system, including six hundred and thirty-eight dollars and five cents (\$638.05) material on hand. All of which is fully set forth in the report herewith submitted of Mr. J. H. Elliott, Engineer-in-charge, and which is made a part of this report. Mr. Elliott's report is full and explicit as to details of cost and construction, and in recommendations for the future, in all of which I fully concur. Having discussed all these points in former reports, it would seem needless to here enlarge further upon the necessity of the work. It has become simply a question of the best method, and of means and time in which to perform the work. Unforeseen difficulties and new problems arise and grow with the growth of the city, and must be met and dealt with in turn as best we can.



**Report of J. H. Elliott, Engineer-in-Charge.**

In the past year there have been added to the general system 1 and  $\frac{18}{100}$  miles of sewers, 3314 feet of which is an addition to the Chelsea system; the remainder—2919½ feet—is an addition to the Waring system. There have been constructed 52 manholes—8 manholes in the Chelsea system and the remainder—44 manholes—in the Waring system. Nine flush tanks have been built, 3 on the Chelsea and 6 on the Waring system.

One hundred and thirty-five obstructions have been removed at a cost of \$718. Attention is called to the fact that whereas the stoppages were more numerous during the past year than the previous years, the cost of removal has diminished. This is attributable to the numerous manholes built, and would urge the building of manholes at every intersection, and at stated intervals throughout the whole system, as rapidly as possible.

The following measurements of depth of sewage flow were made in manholes along the lines of the east and west mains from Vance street north to their junction. Time of measurement between 12 o'clock m. and 2 p.m.:

**WEST MAIN.**

Hadden avenue, north of Vance, 10-inch pipe, depth 8 inches.

Hadden avenue, north of Linden, 12-inch pipe, depth 10½ inches.

Hadden avenue, south of Beale, 12-inch pipe, depth 12½ inches.

Hernando street, north of Beale, 12-inch pipe, depth 12 inches.

Hernando street and Gayoso, 12-inch pipe, depth 21½ inches.

DeSoto street, south of Union, 15-inch pipe, depth 10 inches.

Junction with Monroe street sewer, 15-inch pipe, depth 6 inches.

Between Madison and Court streets, 15-inch pipe, depth 4 inches.

Between Court and Jefferson streets, 15-inch pipe, depth 5 inches.

At Fourth and Poplar, 15-inch pipe, depth  $5\frac{1}{2}$  inches.

At Market, 15-inch pipe, depth 6 inches.

At Winchester, 15-inch pipe, depth 8 inches.

Junction of east and west mains, depth 9 inches.

#### EAST MAIN.

Turley street, north of Linden, 10-inch pipe, depth 6 inches.

Turley street, south of Beale, 10-inch pipe, depth 9 inches.

Gayoso street, 12-inch pipe, depth 9 inches.

Between Union and Monroe, 12-inch pipe, depth 8 inches.

Between Union and Madison, 12-inch pipe, depth 1 inch.

Court, 12-inch pipe, depth  $2\frac{1}{2}$  inches.

Adams street, 12-inch pipe, depth 4 inches.

Poplar street, 12-inch pipe, depth 8 inches.

Carroll street, 12-inch pipe, depth 7 inches.

Winchester street, 12-inch pipe, depth 7 inches.

At bridge, 12-inch pipe, depth 10 inches.

Junction east and west mains, depth 9 inches.

Monroe street sewer at DeSoto street, 24-inch pipe, depth 11 inches.

These measurements show that the mains south of Monroe street are overcharged and should be relieved at once.

The report of the Chelsea system shows 3314 feet of sewers constructed. The 10-inch lateral in alley north of Mill street, running east 1730 feet, was laid at an average depth of 13 feet; maximum depth 20 feet. This was through very treacherous ground, water being very near the surface. Through a large portion of the distance the trench had to be braced to prevent caving, and the sewer pipe had to be kept

up with each day's work, so as to drain the ground for the next day, water in the wells on the adjacent property standing within ten feet of the surface.

Referring to the Chelsea statement, we find the total cost of pipe laid during the past year to be \$9054.99. If from this amount we deduct the cost of the iron bridge across Bayou Gayoso, which properly belongs to the statement of the year 1888, amounting to \$1958.70, and divide the remainder by the length of the pipe laid, 3314 feet, we find the cost per foot of the pipe laid in 1889 to be \$1.24 $\frac{2}{3}$  per foot.

The balance of this work should be pushed to a speedy conclusion, together with an adequate water supply.

As far as the Chelsea system of sewers is concerned, it is simply a question of money, as the present plan, when completed, will thoroughly cover the territory. But there is another problem staring us in the face, and one which cannot be much longer delayed, and that is the relief of the Waring system.

Our city is increasing each year with an accelerated movement; the number of buildings during the past year has exceeded anything known in its history, and the prospects for the coming years are still brighter.

In making any plans at this time we have to consider and discount what the future may have in store for us, as far as is possible, and whatever plan is adopted, and whatever work is done, should be with a clear and full understanding of what the future may bring, and not for our present needs alone.

Let us look at the known factors of the problem and try to reach the desired answer.

They are as follows :

1. A system of sewers which the city in a great measure has outgrown.



2. The outlet of the present system into Wolf River.

During the past summer a bar, which has been forming for a number of years, made its appearance, it may be said almost full grown, directly across the mouth of Wolf River. This will eventually force the extension of the present outlet further south, as originally contemplated by Col. Waring. The small amount of water brought down by this stream, and its consequent sluggish movement during low water, makes it a very undesirable outlet for any large amount of sewage.

3. The topography of Memphis. About a mile south of the southern limits of the city a ridge, starting on the banks of the Mississippi River in Fort Pickering, running almost due east, forms the divide between the waters of Wolf River on the north and Nonconnah Creek on the south. All the country north of this ridge, including the entire city of Memphis, with its eastern and southern suburbs, drains north, forming the different bayous which divide up our city.

These in brief are the three most important factors in our problem. Let us examine them closely and see what they reveal:

1. A system of sewers that the city has outgrown.
2. The discharge of the sewers into Wolf River.
3. The natural drainage of the city and adjacent country from south to north into Wolf River.

The solution of the above is the plan which will utilize the present system, discharge the sewage into the Mississippi River by the most direct route, and utilize the natural drainage to the greatest advantage at the least cost.

The following plan is respectfully submitted, which appears to fill the above conditions:

A line of pipe starting at the foot of Trezevant street, following Trezevant street to and under Main street, thence

along the line of Elliott street to Calhoun street, and through to Bayou DeSoto.

This line would strike the head of the Waring mains (east and west), relieving the Waring system as far north as Monroe street, and would allow of an extension south to McLemore avenue, and east to the Memphis & Charleston Railroad junction.

This would allow of an east extension of the Monroe street sewer under the M. & C. Railroad tracks, which would then become the main instead of a relief sewer, placing the Waring system in the position of sub-mains and laterals. The outlet of the Waring system at Wolf River will have to be moved south sufficiently to allow the discharge to empty into the Mississippi River, and enlarged, looking forward to an extension east, to reach the territory north of the Monroe street sewer line and east of the city limits.

Attention is called to the great improvement in our plumbing work. To the untiring energy of the inspector, Mr. William Lunn, and his hearty interest in his work is this improvement greatly due; and it may also be added that we have in this work, as a rule, the hearty co-operation of the plumbers, who have come to realize that they have, if possible, as much or more interest in first-class plumbing and good sanitary work. They have almost with one accord rendered their support in the execution of the plumbing laws laid down by the Council and Board of Health. These laws, adopted in 1884, are now, for the first time, strictly enforced. Bad plumbing is now a thing of the past. We have been able, with the active assistance afforded us by the Board of Health, to reach a good deal of unsanitary work done in past years, and correct the same. We are pushing this as fast as practicable, and hope that in a short time this class of work will be eliminated from our city.

SUMMARY OF WORK—SEWER DEPARTMENT.

There have been constructed :

1 $\frac{18}{100}$  miles of sewers.  
52 manholes.  
9 flush tanks.

There have been connected with the sewers :

592 water closets.  
439 kitchen and yard sinks.  
108 bath tubs.  
87 wash basins.  
37 urinals.  
1 elevator.  
11 laundry tubs.  
1 cellar drain.  
3 troughs.  
4 drinking slabs.

135 obstructions removed, costing \$718.01.

New lines, 1889, \$11,485.91.

Maintenance, 1889, \$4,740.99.

The system and service of the whole system to date (January 1, 1890), is as follows :

New sewer lines, . . . . .	42 $\frac{75}{100}$ miles
Old sewer lines (bought by T. D), . . . . .	4 $\frac{1}{100}$ miles
Sub-soil drains, . . . . .	36 $\frac{9}{100}$ miles
Flush tanks, . . . . .	217
Manholes, . . . . .	138
Observation holes, . . . . .	515
Catch-basins, . . . . .	23
Water-closets, . . . . .	7535
Slop-sinks, . . . . .	5117
Bath-tubs, . . . . .	779
Wash-basins, . . . . .	622
Urinals, . . . . .	487
Elevators, . . . . .	23
Laundry-tubs, . . . . .	87
Cellar-drains, . . . . .	80
Troughs, . . . . .	3
Drinking-slabs, . . . . .	4



**Detailed Statement of the Cost of Material and Labor Used in the  
Construction of the Chelsea Sewer for the Year 1889.**

**MAIN LINE.**

Iron bridge across bayou.....	\$1,947.00
Lumber .....	11.70—1,958.70

**LATERAL LINES.**

Pipe account Jno. A. Denie.....	\$1,337.60
Cement " " " .....	74.20
Iron Pipe account Dennis Long & Co.....	153.65
Sand account M. M. & B. Co.....	11.25
Brick account Jno. Cubbins.....	5.21
Lumber account Williams & Co.....	54.10
Tools, etc., account Lee Bros. & Co.....	21.20
Labor—Pay roll.....	1,988.05—3,645.26

**FLUSH TANKS AND MANHOLES.**

Making water connections to flush tanks.....	\$ 216.22
Brick account Jno. Cubbins.....	134.83
Cement account Jno. A. Denie.....	56.00
Sand account M. M. & B. Co.....	15.00
Rims and covers account Livermore F. & M. Co.....	142.23
52 steps account Livermore F. & M. Co.....	14.05
Labor account—Pay roll.....	187.11— 765.44
Total .....	\$ 3,369.40

**VITRIFIED PIPE LAID.**

10-inch pipe.....	1,587 feet
10x8-inch Y's, 6 pieces.....	12 feet
10x6-inch Y's 68 pieces.....	136 feet—1,735 feet
8-inch pipe.....	914.5 feet
8x6-inch Y's, 68 pieces.....	136 feet—1,050.5 feet
6-inch pipe.....	468 feet
6x6-inch Y's, 6 pieces.....	12 feet— 480 feet

Total length vitrified pipe laid .....3,265.5 feet

Total length 8-inch iron pipe laid ..... 48.5 feet

Total length of pipe laid.....3,314 feet

Eight manholes. Three flush tanks.

**PIPE ON HAND.**

486 feet 10-inch pipe at 65c.....	\$315.90
16 feet 8 inch pipe at 45c.....	7.20
117 pieces 10x6-inch Y's at \$2.95.....	345.15
31 pieces 8x6-inch Y's at \$2.03.....	62.93— 731.18
Less 57 per cent. off.....	416.77

Value of pipe on hand..... \$ 314.41—6,369.40

Deducting this amount from total..... 314.41

Gives the cost of the sewers for 1889..... \$6,054.99

SUMMARY

Of total length of pipes laid and cost of the Chelsea system to date.

Amount expended in 1888.....\$9,570.99

Amount expended in 1889..... 6,054.99

Total cost to date..... \$15,625.98

TOTAL LENGTH PIPE LAID IN 1888 AND 1889.

20-inch pipe, vitrified.....	577	feet	
20x4 inch Y's, 8 pieces.....	16	feet—	593 feet
18-inch pipe.....	158	feet	
18x4-inch Y's, 25 pieces.....	70	feet—	228 feet
15-inch pipe.....	332	feet	
15x4-inch Y's, 25 pieces.....	50	feet—	382 feet
12-inch pipe.....	127	feet	
12x4-inch Y's, 10 pieces....	20	feet—	147 feet
10-inch pipe.....	2,727	feet	
10x8 inch Y's, 6 pieces.....	12	feet	
10x6-inch Y's, 68 pieces.....	136	feet	
10x4-inch Y's, 72 pieces.....	144	feet—	3,019 feet
8-inch pipe.....	1,510.5	feet	
8x6-inch Y's, 74 pieces.....	148	feet	
8x4-inch Y's, 34 pieces.....	68	feet—	1,726.5 feet
6-inch pipe.....	468	feet	
6x6-inch Y's, 6 pieces.....	12	feet—	480 feet
4-inch pipe.....	1,352	feet—	1,352 feet

Total vitrified pipe laid..... 7,927.5 feet

IRON PIPE.

20-inch pipe.....	
20x4-inch Y's, 6 pieces.....	
20x10-inch Double Y's, 2 pieces.....	434.7 feet
18-inch pipe.....	
18x6-inch Double Y's, 1 piece.....	162.8 feet
10-inch pipe.....	84 feet
8-inch pipe.....	48.5 feet
6-inch pipe.....	34 feet

Total iron pipe laid..... 764 feet

Total vitrified pipe laid.....7,927.5 feet

Total length of pipe.....8,691.5 lin. feet

Total manholes..... 18

Total flush tanks..... 5

**Table Showing Cost of Sewer Department from January 1, 1889, to  
January 1, 1890.**

ENGINEERING.....		\$ 1,276.66
CONSTRUCTION.		
9 new flush tanks.....	\$ 510.49	
52 new manholes.....	2,284.96	
185 house connections.....	1,463.61½	
3314 feet new lines Chelsea system.....	5,605.16	
2919 feet new lines Waring system.....	2,093.16—	11,957.38½
MAINTENANCE.		
Repairing flush tanks.....	\$ 1,648.55	
Repairing manholes.....	43.02	
135 obstructions removed.....	718.01½	
Repairing streets.....	361.11	
Repairing damages.....	30.10	
Repairing sewers.....	127.81	
Cleaning sewers, main.....	89.46	
Cleaning sewers, laterals.....	93.20	
Tools, etc.....	304.48	
Office expenses.....	88.55	
Superintendent.....	1,200.00	
Miscellaneous.....	185.93—	4,890.22½
Total sewers.....		\$18,124.27
Work done and to be charged to Engineer Department (culverts, etc.).....		202.01
Work done on fire systems and to be charged to Fire Department.....		39.87
		\$18,366.15
CREDITS.		
By J. F. Fisher, drawn in December, 1888.....	\$ 50.00	
Paid by Factors' Press, etc.....	15.00	
Paid by A. Rossi & Co.....	11.35	
Paid by Artesian Water Co.....	5.00	81.35
Total amount of vouchers.....		\$18,284.80



## OPERATIONS OF SEWER DEPARTMENT IN 1890

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The expenditures and work in this department are fully set forth in the report herewith submitted of Mr. Jas. H. Elliott, Engineer-in-charge, which is made a part of this report. It will be seen that the report gives the details of cost and distribution of the same in a full and comprehensive manner, leaving but little to be said. I fully concur in the recommendations made by him with regard to future work and the necessity of relief in certain directions.

I think the cut-off in the west main sewer, which he recommends, should be made as soon as practicable, and certainly that part between Gayoso and Monroe streets, in the extension northward on Hernando, across to Monroe street sewer.

It would seem that we have now reached a period in the growth of the city when it has become necessary to build in the near future one or two large intercepting sewers, discharging by independent outlets directly into the river, for which surveys and plans should be made as soon as the time and means will permit. They have been so fully presented and discussed in previous reports, I deem it unnecessary to further enlarge upon the subject, further than to say that no such work should be done, without considering the territory that it is practicable to reach beyond and within a reasonable area of the present city limits. In other words, these sewers should be made sufficiently large to accommodate territory beyond our present limits that may be brought in within a few years. The following statement shows the mileage and cost of sewers from December, 1880, to the present time :

New sewer lines, . . . . .	45 $\frac{2}{10}$ miles
Old sewer lines (bought by T. D.), . . . . .	4 $\frac{1}{10}$ "
Total in operation, . . . . .	49 $\frac{3}{10}$ "

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SUMMARY OF WORK DONE BY THIS DEPARTMENT FROM FEBRUARY, 1879, TO DECEMBER 31, 1890.

Total, embracing construction, maintenance and miscellaneous work:

February 1, 1879, to November 30, 1880,  $25\frac{3}{10}$  miles; old sewers

bought by Taxing District,  $2\frac{1}{10}$ — $26\frac{3}{10}$ .....\$183,086.02

December 1, 1880, to December 1, 1882,  $10\frac{3}{10}$  miles..... 79,050.14

December 1, 1882, to December 1, 1884,  $2\frac{3}{10}$  miles..... 21,595.70

December 1, 1884, to December 1, 1886,  $2\frac{5}{10}$  miles; old sewer

bought, 2 miles,  $4\frac{5}{10}$ ..... 40,666.44

December 1, 1886, to December 1, 1888,  $2\frac{1}{10}$  miles..... 32,794.91

In 1889,  $1\frac{1}{10}$  miles..... 18,284.80

In 1890,  $2\frac{4}{10}$  miles..... 23,836.17

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Grand total  $49\frac{8}{10}$  miles.....\$399,314.18

Average per mile, about \$8,100.

**Report of J. H. Elliott, Engineer-in-Charge.**

During the year  $2\frac{4}{10}$  miles of sewers have been built, 3610 feet of which is an addition to the Chelsea system, 8088 feet to the Waring system, and 1258 feet an independent line (12-inch pipe) on Beale street, commencing opposite Mulberry street and running west to the river — Grand Opera House sewer.

There have been constructed 103 new manholes:

62 on the old lines of the Waring system.

32 on the new lines of the Waring system.

9 on the new lines of the Chelsea system.

Also 15 flush tanks, as follows:

2 on the old lines of the Waring system.

10 on the new lines of the Waring system.

3 on the new lines of the Chelsea system.

300 house connections have been made with the sewers during the year; 134 obstructions have been removed at a cost of \$568.63, average \$4.24, a reduction of \$1.08 per stoppage from 1889.

Below will be found table of sewers, as laid in the different wards, with total cost and size of pipe :

Wards	12-In. Pipe	10 In. Pipe	8-In. Pipe	6-In. Pipe	4-In. Pipe	Total Length	Cost
First .....				266'		266'	\$144.86
Fourth.....	1258'		88'	166'		1512'	2,129.95
Fifth.....				258'	154'	412'	329.15
Sixth.....				287'	10'	297'	293.50
Seventh.....				553'	224'	948'	465.04
Eighth.....				3867'	276'	4143'	2,707.85
Ninth.....	240'	2577'	672'	566'		4055'	3,545.81
Tenth.....			2259'	674'	540'	3273'	1,748.89
Total.....	1498'	2577'	3019'	6637'	1004'	14906'	\$11,365.05

The increase in cost of keeping clear the east and west mains, south of their junction with the Monroe street sewer, shows the need of some action for the relief of those two main lines. During the past summer levels were taken in the man-holes on the west main from Vance street north to its junction with the Monroe sewer and profile and map made of the line, which show the following result :

Between Vance and Pontotoc the main line shows a depression or dip of 0.4 feet, and between Linden and Beale streets another of 0.6 feet, as the main sewer at this point is only a 12-inch pipe ; these dips greatly reduce the capacity of this important line, and unless continually cleaned would soon fill up from deposits. The only remedy for this, is to construct a new line from Vance to Beale in either the east or west sidewalk. Again, following this line north, the profile and original notes show a level of about 500 feet in alley south of Union street between Hernando and DeSoto streets ; this further retards the already diminished flow. The remedy for this is easily found. Referring to the map, we find that the sewer leaves Hernando street with a sharp curve, and runs east to DeSoto street, through the alley south of Union street, thence north-east across DeSoto street, and through



private property on Monroe street to its junction with the Monroe street sewer just west of the bayou. Now, if at Hernando street instead of turning east we continue the line in the east sidewalk of Hernando street to and across Union street and through alley east of Third street to the Monroe street sewer, we not only shorten the line 350 feet, but also obtain an increased fall of 3 feet. This pipe should be 18 inches and run through to Vance street, the welfare of the numerous branches of which this line is the outlet being dependent on its flow capacity. This line has been relieved by an overflow into the bayou at the culvert at the intersection of Hernando and Gayoso streets. During the past summer two other overflows into the bayou have been built, one on the west main south of Vance, and the other on the east main at the north line of Vance street.

We were compelled to relieve the sewers in some way before cutting the pipe in several manholes built for the purpose of cleaning the mains. After cutting the pipes these overflows were sealed up. These facts are stated to show the urgent need of some relief for our main lines. We are now at that point, that unless some relief is given the east and west mains by an intercepting sewer south of Vance street, the question is forced on us, of which of two evils to choose, the retention of sewage in the sewers, caused by being overcharged and consequently in the house connections, etc., or the discharge of surplus sewage into the bayous.

There is another fact which should be remedied as soon as possible, and that is the discharge of storm water through our sewers, after heavy rains the depth of water in the manholes being as much as 4 feet in places. A great many houses have direct connection with the sewers from their down spouts; yards are filled up and graded so as to drain off through the

slop sinks. There are also a great many localities which have no other outlet for storm water except through the sewers. An instance of this is furnished in Cow alley, between Poplar and Exchange streets. This alley is in a depression, and the original drainage was west across High street. High street has been filled up, and the lot east of High street, thus cutting off all drainage. The drainage from this large area all passes through a 6-inch sewer. This pipe is continually stopping up from sediment brought in through 3 inlets in Cow alley; through which the storm water enters. These inlets should be removed and the alley opened to High street, properly graded, curbed and paved, in accordance with plan prescribed in 1889. The cost of right of way and paving will not exceed \$2000. There is not a more unsanitary situation in the city, nor one that requires more immediate attention. It requires but a cursory examination of its situation to sustain the facts herein stated. It becomes an absolute necessity to put in these three inlets to the sewer, to relieve the neighborhood of a large pond of water—at the time. They should now be closed, and the alley opened and paved to carry the storm water. The appointment of some active man is recommended, whose business it should be to hunt up these places and take out warrants against all persons who drain their yards or roofs, or in any way turn storm water into the sewers. Attention is also called to the outlet of the storm water drain at the foot of Beale street, into which the Grand Opera House sewer empties. The dump boat is directly over the outlet, and the garbage dumped into the river at that point has entirely stopped it up, so that the storm water and sewage is now forcing an outlet through the pavement on the levee. This will cause serious damage, and should be attended to.

The work in Chelsea was seriously retarded by the delay in shipment of pipe ordered early in the summer, and which did not arrive until some time in November.

For work done on Chelsea sewers, see table.

The 10-inch sub-main in the alley north of Saffarans street has been held down, so as to admit of an extension east to Manassas street. A great deal of water was encountered in all trenches, making the work more costly and difficult.

The force under Mr. J. T. Ferguson is at present laying the line in the alley north of Looney street. On the completion of this line, the force will be moved back and finish up all the laterals. This is very important, as nearly all the house connections are made with these branches, besides getting the necessary flow of water for the main pipe from the flush tanks, which are placed at the ends of these branches.



## CHELSEA SEWERS.

	Size of Pipe					Total Length of Pipe Laid	No. of Manholes	No. of Flush Tanks	Cost			Depth	
	Lines		House Connections						Material	Labor	Total	Greatest	Average
	12-In.	10-In.	8-In.	6-In.	4-In.								
Extension of main sewer.....	240	529	.....	44	.....	813'	2	...	\$ 291.43	\$ 169.70	\$ 461.13	10.10	3.00
Sub-main in alley N. of Saffarans and E. of Second street.....	.....	2048	.....	190	.....	2238'	6	1	837.21	1,395.15	2,232.36	18.01	11.28
Lateral E. of Third, N. across Mill street.....	.....	.....	362	202	.....	564'	1	1	137.46	249.63	387.09	10.76	8.55
Lateral in alley E. of Sixth, S. to Saffarans street.....	.....	.....	160	64	.....	224'	...	...	36.26	96.20	132.46	12.38	11.44
Lateral in alley E. of Seventh, S. to Saffarans street.....	.....	.....	150	66	.....	216'	1	1	70.41	70.00	140.41	14.63	11.30
Lateral in alley S. of Mill and E. of Second street (iron).....	.....	.....	121	.....	50	171'	...	...	175.06	17.30	192.36	.....	.....
Total.....	240'	2577'	793'	566'	50'	4226'	9	3	1,547.83	1,997.98	3,545.81	.....	.....

The work done on the Waring system was greatly increased by the delay in the Chelsea work, most of the lines built being extensions of 6-inch branches, and there being a large stock of this size pipe in town, the construction force was kept busy while waiting on the Chelsea pipe.

For work done on the Waring system, see table.

Thanks are due from this Department to Messrs. Woods & McGrath, J. A. Bailey & Co., and other plumbers for loan of pipe, which has since been returned by Messrs. Jno. A. Denie & Sons.

The Grand Opera House sewer was built early in the season. This is a 12-inch sewer and commences on the north side of Beale street opposite Mulberry street, and runs west and empties into the storm water drain at the foot of Beale street. At the Main street crossing the sewer is 19.5 feet deep, allowing for extensions north and south on Main street.

For work done on this line, see table.

## WARING SYSTEM.

	Size of Pipe				Total Length of Pipe Laid	No. of Manholes	Cost			Depth	
	Lines		House Connections				Material	Labor	Total	Greatest	Average
	12-In.	8 In.	6-In.	4-In.							
Sub-main S. on Lea street from Calhoun.....	2250	598	76	340	3273'	10 2	\$ 786.37	\$ 962.52	\$1748.89	11.08	5.16
Extension of Washington street sewer.....		1572	.....	132	1704'	6 1	466.77	855.10	1,321.87	19.04	11.57
Conway branch from Washington street.....		486	.....	.....	486'	1 1	108.73	143.29	252.02	7.66	5.76
Lateral on Pontotoc W. from Turley street.....		258	.....	154	412'	1 1	133.53	195.62	329.15	6.05	4.40
Extension of lateral N. of Court E. from Manassas.....		547	.....	42	589'	3 ..	147.87	249.09	396.96	15.35	9.77
Lateral on Jones avenue N. from Hawley.....		774	.....	76	850'	1 2	176.10	321.94	498.04	8.75	7.00
Lateral E. of Lauderdale and N. of Union street.....		434	.....	224	658'	3 1	136.92	216.09	403.01	.....	.....
Various short branches from 40 to 200 feet long.....		1160	.....	36	1196'	3 1	275.09	464.26	739.35	.....	.....
Total.....	2250'	5829'	76'	1004'	9168'	28 9	2,281.38	3,407.91	5,689.29	.....	.....
INDEPENDENT LINE—											
Grand Opera House Sewer.											
On Beale street W. from Mulberry to the river.....	1258'	88	166	.....	1512'	4 1	1,112.01	1,017.94	2,129.95	19.50	15.40



This line cost \$2,129.95. Of this amount the Grand Opera House Co. paid \$800, Mr. W. M. Randolph paid \$454, and the city paid \$875.95. Sixty-two (62) new manholes have been built on the different old lines of the Waring system, at such points as would give the best control of the different branches in the event of stoppages. The beneficial results are shown in the decreased cost per stoppage, and the saving in time, as shown by the increased number of house connections made.

For the coming year, 1891, we start out with a well-organized force at work on the Chelsea system. This work should be pushed to completion the coming year, if possible.

Another force should be organized and work started on the following lines, starting on Auction street at the alley east of second street and running east, following the bayou south of the L. & N. R. R. to the city limits. This line would embrace all the low country north and south of the L. & N. R. R., including Manassas, Ross and Dunlap streets.

Passing to south-east Memphis the 8-inch line, which ends at the Lemmon property on Orleans street, should be pushed south and east, following the bayou.

This line will reach the large and thickly-settled territory lying east of Lauderdale and south of Georgia and Tate streets. Any extensive additions to the west main are not recommended, until either the present defects along Hadden avenue north, already mentioned, are remedied, or a new outlet built through to the river south of Vance.

The natural drainage of Ft. Pickering, as far south as the city limits, is north. A line built along Elliott street, tapping the east and west mains of the Waring system, and run-

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ning west under Main and Trezevant streets to the river, would not only relieve the Waring system, but, by following the various bayous south with branch lines, reach all the territory west of Mississippi avenue and south of Webster street, including Ft. Pickering.

Any system of sewers which may be adopted for southwest Memphis should be of sufficient size and capacity, not only to carry of the sewage, but to accommodate the waste from any and all factories, etc., which may be located there in the future.

Table Showing Cost of Sewer Department from January 1 to December 31, 1890, Inclusive.

ENGINEERING .....		\$1,400.00
CONSTRUCTION.		
2 flush tanks.....	\$	77.85
62 manholes.....		2,282.80
300 house connections.....		1,877.15
NEW LINES.		
1258 feet Grand Opera House Sewer, 1 flush tank, 4 manholes, 254 feet house connections.....		2,129.95
8088 feet Waring system, 9 flush tanks, 28 manholes, 1080 feet house connections.....		5,689.29
3610 feet Chelsea system, 3 flush tanks, 9 manholes, 616 feet house connections.....		3,545.81— 15,602.85
MAINTENANCE.		
Repairing flush tanks .....	1,938.16½	
Repairing manholes.....	66.79½	
134 obstructions.....	568.63	
Repairing streets.....	137.86½	
Repairing damages to property.....	60.90	
Repairing sewers.....	243.16	
Cleaning main sewers .....	614.43½	
Cleaning lateral sewers.....	115.45	
Tools, etc.....	843.13	
Office expenses.....	212.50	
Superintendent.....	1,275.00	
Miscellaneous .....	34.26—	6,110.29
Total sewers .....		\$23,113.14
Various work done and to be charged to the Engineer Department.....		723.03
Total amount of vouchers.....		\$23,836.17
CREDITS.		
Grand Opera House Co.....	\$	800.00
Wm. M. Randolph.....		454.00
Conway sewer.....		500.00
Geo. Love.....		96.20
Massa Bros.....		5.35
J. A. Bailey & Co.....		5.25
Blackmer & Post.....		86.40
Amount to be charged to the Engineer Department...	723.03—	2,670.23
Cost of the Sewer Department.....		\$21,165.94
There is also due from the Artesian Water Co., but not yet collected:		
Water supply to flush tanks made by this department during 1890.....		1,566.06
Making actual cost to city.....		\$19,599.88

### Summary of Work—Sewer Department.

There have been constructed  $2\frac{45}{100}$  miles of sewers,  $\frac{37}{100}$  miles house connections, 103 manholes, 15 flush tanks.

There have been connected with the sewers:

	New Fixtures.	Old Fixtures Remodeled.
Water closets.....	742	236
Slop sinks.....	570	151
Wash stands.....	102	31
Bath tubs.....	152	58
Urinals.....	62	18
Wash tubs.....	5	5
Catch basins.....	6	2
Bedett pan.....	1	.....
Latrines.....	2	2
Ventilating pipes.....	.....	18
Cellar drains.....	.....	2
134 obstructions removed, costing.....		\$ 568.63
New lines, 1890.....		11,365.05
Maintenance.....		6,110.29

The system and service of the whole system to date, January 1, 1891, is as follows:

New sewer lines.....	45 $\frac{20}{100}$ miles.
Old sewer lines (bought by T. D.).....	4 $\frac{10}{100}$ miles.
Subsoil drains.....	36 $\frac{2}{100}$ miles.
Flush tanks.....	227
Manholes.....	241
Observation holes.....	515
Catch basins.....	29
Water closets.....	8277
Slop sinks.....	5687
Bath tubs.....	931
Wash stands.....	724
Urinals.....	549
Elevators.....	.....
Laundry tubs.....	92
Cellar drains.....	82
Latrines.....	4
Troughs.....	3







